



**ENVIRONMENTAL PROTECTION AGENCY**

6560-50-P

**40 CFR Part 82**

**[EPA-HQ-OAR-2003-0118; FRL-9946-88-OAR]**

**RIN 2060-AG12**

**Protection of Stratospheric Ozone: Determination 31 for Significant New Alternatives Policy Program**

**AGENCY:** Environmental Protection Agency (EPA).

**ACTION:** Determination of acceptability.

**SUMMARY:** This determination of acceptability expands the list of acceptable substitutes pursuant to the U.S. Environmental Protection Agency's (EPA) Significant New Alternatives Policy (SNAP) program. This action lists as acceptable additional substitutes for use in the refrigeration and air conditioning sector.

**DATES:** This determination is effective on [**Insert date of publication in the Federal Register**].

**ADDRESSES:** EPA established a docket for this action under Docket ID No. EPA-HQ-OAR-2003-0118 (continuation of Air Docket A-91-42). All electronic documents in the docket are listed in the index at [www.regulations.gov](http://www.regulations.gov). Although listed in the index, some information is not publicly available, i.e., Confidential Business Information (CBI) or other information whose disclosure is restricted by statute. Publicly available docket materials are available either electronically at [www.regulations.gov](http://www.regulations.gov) or in hard copy at the EPA Air Docket (Nos. A-91-42 and EPA-HQ-OAR-2003-0118), EPA Docket Center (EPA/DC), William J. Clinton West, Room 3334, 1301 Constitution Avenue, NW,

Washington, DC 20460. The Public Reading Room is open from 8:30 a.m. to 4:30 p.m., Monday through Friday, excluding legal holidays. The telephone number for the Public Reading Room is (202) 566-1744, and the telephone number for the Air Docket is (202) 566-1742.

**FOR FURTHER INFORMATION CONTACT:** Gerald Wozniak by telephone at (202) 343-9624, by e-mail at [wozniak.gerald@epa.gov](mailto:wozniak.gerald@epa.gov), or by mail at U.S. Environmental Protection Agency, Mail Code 6205T, 1200 Pennsylvania Avenue, NW, Washington, DC 20460. Overnight or courier deliveries should be sent to the office location at 1201 Constitution Avenue, NW, Washington, DC 20004.

For more information on the Agency's process for administering the SNAP program or criteria for the evaluation of substitutes, refer to the initial SNAP rulemaking published in the Federal Register on March 18, 1994 (59 FR 13044). Notices and rulemakings under the SNAP program, as well as other EPA publications on protection of stratospheric ozone, are available at EPA's Ozone Layer Protection website at [www.epa.gov/ozone-layer-protection](http://www.epa.gov/ozone-layer-protection) including the SNAP portion at [www.epa.gov/snap/](http://www.epa.gov/snap/).

## **SUPPLEMENTARY INFORMATION:**

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### Appendix A: Summary of Decisions for New Acceptable Substitutes

## **I. Listing of New Acceptable Substitutes**

This action presents EPA's most recent decision to list as acceptable several substitutes in the refrigeration and air conditioning sector. New substitutes are:

- CO<sub>2</sub> in several refrigeration and air conditioning end-uses;
- Hydrofluoroolefin<sup>1</sup> (HFO)-1336mzz(Z) in several refrigeration and air conditioning end-uses;
- HFO-1336mzz(Z)/*trans*-1,2-dichloroethylene blend (74.7/25.3) (proposed designation R-514A) in two refrigeration and air conditioning end-uses; and
- R-513A in retail food refrigeration—food processing and dispensing equipment.

For copies of the full list of acceptable substitutes for ozone depleting substances (ODS) in all industrial sectors, visit the SNAP portion of EPA's Ozone Layer Protection website at [www.epa.gov/snap/substitutes-sector](http://www.epa.gov/snap/substitutes-sector). Substitutes listed as unacceptable; acceptable, subject to narrowed use limits; or acceptable, subject to use conditions are also listed in the appendices to 40 CFR part 82, subpart G.

The sections below discuss each substitute listing in detail. Appendix A contains tables summarizing today's listing decisions for these new substitutes. The statements in the "Further Information" column in the tables provide additional information, but are not legally binding under section 612 of the Clean Air Act (CAA). In addition, the "Further

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<sup>1</sup> Hydrofluoroolefins are unsaturated hydrofluorocarbons having at least one double bond.

Information” column may not include a comprehensive list of other legal obligations you may need to meet when using the substitute. Although you are not required to follow recommendations in the “Further Information” column of the table to use a substitute consistent with section 612 of the CAA, some of these statements may refer to obligations that are enforceable or binding under federal or state programs other than the SNAP program. In many instances, the information simply refers to standard operating practices in existing industry standards and/or building codes. When using these substitutes, EPA strongly encourages you to apply the information in this column. Many of these recommendations, if adopted, would not require significant changes to existing operating practices.

You can find submissions to EPA for the substitutes listed in this document, as well as other materials supporting the decisions in this action, in Docket EPA-HQ-OAR-2003-0118 at [www.regulations.gov](http://www.regulations.gov).

#### *A. Refrigeration and Air Conditioning*

##### *1. Carbon Dioxide (R-744)*

*EPA’s decision: EPA finds carbon dioxide (CO<sub>2</sub>) acceptable as a substitute for use in:*

- Ice skating rinks (new equipment)
- Centrifugal chillers (new equipment)
- Positive displacement chillers<sup>2</sup> (new equipment)
- Industrial process air conditioning (new equipment)

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<sup>2</sup> Examples of positive displacement chillers include reciprocating, screw, and scroll chillers. EPA has previously used those terms in acceptability listings for this end-use.

Carbon dioxide is also known as R-744 when used as a refrigerant. Its Chemical Abstracts Service Registry Number (CAS Reg. No.) is 124-38-9.

You may find the redacted submissions in Docket EPA-HQ-OAR-2003-0118 at [www.regulations.gov](http://www.regulations.gov) under the names, “SNAP Information Notice for CO<sub>2</sub> (R-744) in Ice Skating Rinks” and “SNAP Information Notice for CO<sub>2</sub> (R-744) in Chillers and Industrial Process Air Conditioning.” EPA performed assessments to examine the health and environmental risks of this substitute when used in these end-uses. These assessments are available in Docket EPA-HQ-OAR-2003-0118 under the following names:

- “Risk Screen on Substitutes in Ice Skating Rinks Substitute: Carbon Dioxide (CO<sub>2</sub> or R-744)”
- “Risk Screen on Substitutes in Commercial and Industrial Heat Pumps Substitute: Carbon Dioxide (CO<sub>2</sub> or R-744)”
- “Risk Screen on Substitutes for Use in Chillers and Industrial Process Air-Conditioning Substitute: Carbon Dioxide (CO<sub>2</sub> or R-744)”

EPA previously listed CO<sub>2</sub> as an acceptable refrigerant in a number of other refrigeration and air conditioning end-uses, including industrial process refrigeration, and in the case of motor vehicle air conditioning as acceptable subject to use conditions, (e.g., January 13, 1995, 60 FR 3318; September 30, 2009, 74 FR 50129; June 16, 2010, 75 FR 34017; June 6, 2012, 77 FR 33315; August 10, 2012, 77 FR 47768; October 21, 2014, 79 FR 62863).

*Environmental information:* CO<sub>2</sub> has an ozone depletion potential (ODP) of zero.<sup>3</sup> The 100-year global warming potential (GWP) of CO<sub>2</sub> is one.<sup>4</sup>

EPA's regulation codified at 40 CFR part 82, subpart F exempts CO<sub>2</sub> refrigerant from the venting prohibition under section 608(c)(2) of the CAA (March 12, 2004, 69 FR 11946).<sup>5</sup> The CAA and EPA's venting regulations prohibit the intentional venting or release of substitutes for class I or class II ODS during the repair, maintenance, service or disposal of refrigeration and air conditioning appliances, unless EPA expressly exempts a particular substitute refrigerant from the venting prohibition, as for CO<sub>2</sub>.

CO<sub>2</sub> is excluded from the definition of volatile organic compounds (VOC) under CAA regulations (see 40 CFR 51.100(s)) addressing the development of state implementation plans (SIPs) to attain and maintain the national ambient air quality standards (NAAQS).

*Flammability information:* CO<sub>2</sub> is not flammable.

*Toxicity and exposure data:* Potential health effects of exposure to this substitute at lower concentrations include loss of concentration, headache and shortness of breath. The substitute may also irritate the skin or eyes or cause frostbite. At sufficiently high concentrations, it may cause central nervous system depression. The substitute could cause asphyxiation if air is displaced by vapors in a confined space. For additional

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<sup>3</sup> EPA assumes that compounds containing no chlorine, bromine, or iodine have an ODP of zero.

<sup>4</sup> Unless otherwise stated, all GWPs in this document are 100-year values from: IPCC, 2007: *Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* [Solomon, S., Qin, D., Manning, M., Chen, Z., Marquis, M., Averyt, K. B., Tignor M., and Miller, H. L. (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. This document is accessible at [www.ipcc.ch/publications\\_and\\_data/ar4/wg1/en/contents.html](http://www.ipcc.ch/publications_and_data/ar4/wg1/en/contents.html).

<sup>5</sup> For more information, including definitions, see 40 CFR part 82 subpart F.

information concerning potential health risks of CO<sub>2</sub>, see EPA's final rule under the SNAP program for use of CO<sub>2</sub> as a refrigerant in motor vehicle air conditioning systems (June 6, 2012, 77 FR 33315) and EPA's risk screens in docket EPA-HQ-OAR-2003-0118.

To mitigate these potential health risks in the workplace, CO<sub>2</sub> has an 8 hour/day, 40 hour/week permissible exposure limit (PEL) of 5,000 ppm required by the Occupational Safety and Health Administration (OSHA). It also has a 15-minute recommended short-term exposure limit (STEL) of 30,000 ppm established by the National Institute for Occupational Safety and Health (NIOSH). EPA recommends that users follow all requirements and recommendations specified in the manufacturer's safety data sheet (SDS), in the American Society for Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) Standard 15, and other safety precautions common to the refrigeration and air conditioning industry. We also recommend that users of CO<sub>2</sub> adhere to NIOSH's STEL and to ASHRAE 15, and we expect that users will meet OSHA's PEL. EPA anticipates that users will be able to address potential health risks by complying with the PEL and by following requirements and recommendations in the SDS, in ASHRAE 15, and other safety precautions common in the refrigeration and air conditioning industry.

*Comparison to other substitutes in these end-uses:* CO<sub>2</sub> has an ODP of zero, comparable<sup>6</sup> to or lower than other substitutes listed as acceptable in these end-uses, with ODPs ranging from zero to 0.098.

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<sup>6</sup> This is in contrast to the historically used ODS hydrochlorofluorocarbon (HCFC)-22 with an ODP of 0.055. Throughout this document, ODP values cited for class I and class II ODS are from EPA's regulations at appendix A to subpart A of 40 CFR part 82.

In ice skating rinks, many substitutes listed as acceptable have higher GWPs than the GWP of one for CO<sub>2</sub>. HFC-134a, R-404A, THR-03 and other HFC blends have GWPs ranging from 920 to 3,990; other substitutes listed as acceptable for ice skating rinks that have a comparable or lower GWP include ammonia absorption and ammonia vapor compression with a GWP of zero.

In centrifugal and positive displacement chillers, most other substitutes listed as acceptable have higher GWPs than CO<sub>2</sub>, such as R-450A, R-513A, HFC-134a, R-404A and other HFC blends, with GWPs ranging from approximately 600 to 3,990.<sup>7</sup> CO<sub>2</sub>'s GWP of one is comparable to or lower than that of several other acceptable substitutes for new equipment within these end-uses including ammonia absorption and ammonia vapor compression, HFO-1234ze(E), and for centrifugal chillers only, *trans*-1-chloro-3,3,3-trifluoroprop-1-ene, with GWPs in the range of zero to seven.

In industrial process air conditioning, most other substitutes listed as acceptable have higher GWPs than CO<sub>2</sub>, such as R-513A, R-450A, HFC-134a, R-404A and other HFC blends with GWPs ranging from approximately 600 to 3,990. CO<sub>2</sub>'s GWP of one is comparable to or lower than several other acceptable substitutes for new equipment in industrial process air conditioning including ammonia absorption and ammonia vapor compression with a GWP of zero and HFO-1234ze(E) with a GWP of one to six.

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<sup>7</sup> In a proposed rule published April 18, 2016 (81 FR 22809), EPA proposed to change the status of a number of substitutes from acceptable to unacceptable for use in new centrifugal chillers and in new positive displacement chillers. Those substitutes had GWPs ranging from 920 to 3,990 in both end-uses. If EPA takes final action as proposed, there would still be several substitutes that remain acceptable and that have higher GWPs than CO<sub>2</sub>, including HFO-1234ze(E), IKON B, R-450A, R-513A, and THR-02 for both end-uses, and for centrifugal chillers also IKON A and *trans*-1-chloro-3,3,3-trifluoroprop-1-ene, with GWPs ranging from approximately 30 to 630.



Flammability and toxicity risks of this substitute are comparable to or lower than the flammability and toxicity risks of other available substitutes in the same end-uses. Flammability risks are low, as discussed above. The toxicity risks are similar to those for many other refrigerants and, as with those other refrigerants, can be minimized by use consistent with the OSHA PEL, NIOSH STEL, ASHRAE 15 and other industry standards, recommendations in the SDS, and other safety precautions common in the refrigeration and air conditioning industry.

EPA finds CO<sub>2</sub> acceptable in these end-uses listed above, because the overall environmental and human health risk posed by CO<sub>2</sub> is lower than or comparable to the risks posed by other available substitutes in the same end-uses.

## 2. HFO-1336mzz(Z) (Opteon® MZ)

*EPA's decision: EPA finds HFO-1336mzz(Z) acceptable as a substitute for use in:*

- Centrifugal chillers (new equipment)
- Positive displacement chillers (new equipment)
- Industrial process air conditioning (new equipment)
- Non-mechanical heat transfer (new and retrofit equipment)

HFO-1336mzz(Z) is also known as (Z)-1,1,1,4,4,4-hexafluorobut-2-ene and *cis*-1,1,1,4,4,4-hexafluorobut-2-ene (CAS Reg. No. 692-49-9), and goes by the trade name of Opteon® MZ.

You may find the redacted submission in Docket EPA-HQ-OAR-2003-0118 at [www.regulations.gov](http://www.regulations.gov) under the name, "SNAP Information Notice for Opteon® MZ."

EPA performed assessments to examine the health and environmental risks of this substitute in these end-uses. These assessments are available in docket EPA-HQ-OAR-2003-0118 under the following name:

- “Risk Screen on Substitutes for Use in Chillers and Industrial Process Air Conditioning Substitute: HFO-1336mzz(Z) (Opteon® MZ).”
- “Risk Screen on Substitutes for Use in Heat Transfer Substitute: HFO-1336mzz(Z) (Opteon® MZ).”

We have previously listed HFO-1336mzz(Z) as an acceptable foam blowing agent in a number of foam blowing end-uses (October 21, 2014, 79 FR 62863; July 16, 2015, 80 FR 42053).

*Environmental information:* HFO-1336mzz(Z) has an ODP of zero. It has a 100-year GWP of about nine.<sup>8</sup> HFO-1336mzz(Z) is a VOC and it is not exempted from the definition of VOC under CAA regulations (see 40 CFR 51.100(s)) addressing the development of SIPs to attain and maintain the NAAQS. The manufacturer has petitioned EPA to exempt HFO-1336mzz(Z) from the definition of VOC under those regulations, based on its claim that the chemical exhibits low photochemical reactivity. Knowingly venting or releasing this refrigerant is limited by the venting prohibition under section 608(c)(2) of the CAA, codified at 40 CFR 82.154(a)(1).

*Flammability information:* HFO-1336mzz(Z) is not flammable.

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<sup>8</sup> Baasandorj, M., Ravishankara, A. R., Burkholder, J. B., Atmospheric Chemistry of (Z)-CF<sub>3</sub>CH=CHCF<sub>3</sub>: OH Radical Reaction Rate Coefficient and Global Warming Potential, *Journal of Physical Chemistry A*, 2011, 115, 10,539–10,549, 2011.

*Toxicity and exposure data:* Potential health effects of this substitute include skin or eye irritation or frostbite. At sufficiently high concentrations, the substitute may cause irregular heartbeat. The substitute could cause asphyxiation if air is displaced by vapors in a confined space. EPA issued a Significant New Use Rule under the Toxic Substances Control Act on June 5, 2015, to require persons to submit a Significant New Use Notice to EPA at least 90 days before they manufacture or process HFO-1336mzz(Z) for uses other than those described in the Premanufacture Notice (80 FR 32003, 32005).

EPA anticipates that HFO-1336mzz(Z) will be used consistent with the recommendations specified in the SDS. The Workplace Environmental Exposure Limit (WEEL) committee of the Occupational Alliance for Risk Science (OARS) recommends a WEEL for the workplace of 500 ppm on an 8-hour time-weighted average (TWA).<sup>9</sup> EPA anticipates that users will be able to meet the WEEL and address potential health risks by following requirements and recommendations in the SDS and other safety precautions common to the refrigeration and air conditioning industry.

*Comparison to other substitutes in these end-uses:* HFO-1336mzz(Z) has an ODP of zero, comparable<sup>10</sup> to or lower than other acceptable substitutes in these end-uses, with ODPs ranging from 0 to 0.02.

In centrifugal and positive displacement chillers, most other substitutes listed as acceptable have higher GWPs than HFO-1336mzz(Z), such as R-450A, R-513A, HFC-134a, R-404A and other HFC blends with GWPs ranging from approximately 600 to

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<sup>9</sup> The documentation may be viewed at [www.tera.org/OARS/HFO-1336mzz-Z%20WEEL%20FINAL.pdf](http://www.tera.org/OARS/HFO-1336mzz-Z%20WEEL%20FINAL.pdf).

<sup>10</sup> In contrast, the historically used ODS CFC-11, CFC-12 and HCFC-22 have ODPs ranging from 0.055 to 1.0.

3,990.<sup>11</sup> HFO-1336mzz(Z)'s GWP of about nine is comparable to or higher than several other acceptable substitutes for new equipment within these end-uses including ammonia absorption and ammonia vapor compression, HFO-1234ze(E), and for centrifugal chillers only, *trans*-1-chloro-3,3,3-trifluoroprop-1-ene, with GWPs in the range of zero to seven.

In industrial process air conditioning, most other substitutes listed as acceptable have higher GWPs than HFO-1336mzz(Z), such as R-513A, R-450A, HFC-134a, R-404A and other HFC blends with GWPs ranging from approximately 600 to 3,990. HFO-1336mzz(Z)'s GWP of about nine is comparable to or higher than several other acceptable substitutes for new equipment in industrial process air conditioning including ammonia absorption and ammonia vapor compression with a GWP of zero and HFO-1234ze(E) with a GWP of one to six.

In non-mechanical heat transfer, most other substitutes listed as acceptable have higher GWPs such as HFC-245fa, HFC-134a and HFC-125 with GWPs ranging from 1,030 to 3,500. HFO-1336mzz(Z)'s GWP of about nine is comparable to or higher than those of several other acceptable substitutes in the same end-use, such as *trans*-1-chloro-3,3,3-trifluoroprop-1-ene, HFO-1234ze(E), CO<sub>2</sub> and ethane, with GWPs in the range of one to seven.

Flammability and toxicity risks of this substitute are comparable to or lower than the flammability and toxicity risks of other available substitutes in the same end-uses.

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<sup>11</sup> In a proposed rule published April 18, 2016 (81 FR 22809), EPA proposed to change the status of a number of substitutes from acceptable to unacceptable for use in new centrifugal chillers and in new positive displacement chillers. Those substitutes had GWPs ranging from 920 to 3,990 in both end-uses. If EPA takes final action as proposed, there would still be several substitutes that remain acceptable and that have higher GWPs than HFO-1336mzz(Z), including IKON B, R-450A, R-513A, and THR-02 for both end-uses, and for centrifugal chillers also IKON A, with GWPs ranging from approximately 30 to 630.

Flammability risks are low, as discussed above. Toxicity risks can be minimized by use consistent with the OARS WEEL, ASHRAE 15 and other industry standards, recommendations in the SDS, and other safety precautions common in the refrigeration and air conditioning industry.

EPA finds HFO-1336mzz(Z) acceptable in the end-uses listed above, because the overall environmental and human health risk posed by HFO-1336mzz(Z) is lower than or comparable to the risks posed by other available substitutes in the same end-uses.

3. HFO-1336mzz(Z)/*trans*-1,2-dichloroethylene blend (74.7/25.3) (Proposed R-514A, Opteon® XP30)

*EPA's decision: EPA finds the blend HFO-1336mzz(Z)/trans-1,2-dichloroethylene (74.7/25.3) acceptable as a substitute for use in:*

- Centrifugal chillers (new and retrofit equipment)
- Positive-displacement chillers (new and retrofit equipment)

This refrigerant is a weighted blend of 74.7 percent HFO-1336mzz(Z) and 25.3 percent *trans*-1,2-dichloroethylene (CAS Reg. No. 156-60-5). ASHRAE has proposed a designation of R-514A for this refrigerant blend. This blend is marketed under the trade name Opteon® XP30.

You may find the redacted submission in Docket EPA-HQ-OAR-2003-0118 at [www.regulations.gov](http://www.regulations.gov) under the name, "SNAP Information Notice for Opteon® XP30." EPA performed assessments to examine the health and environmental risks of this substitute in this end-use. These assessments are available in docket EPA-HQ-OAR-2003-0118 under the following name:

- “Risk Screen on Substitutes in Chillers Substitute: HFO-1336mzz(Z)/*trans*-1,2-dichloroethylene Blend (74.7/25.3) (Opteon® XP30).”

*Environmental information:* Environmental information on HFO-1336mzz(Z) is described above in listing A.2 of this document. *Trans*-1,2-dichloroethylene has an ODP of approximately 0.00024<sup>12</sup> and the blend would have a weighted ODP value of (approximately 0.00006). We are unaware of a calculated GWP value for *trans*-1,2-dichloroethylene in the peer-reviewed literature, but we expect its GWP is less than five based on its structure and its atmospheric lifetime of 12.7 days.<sup>13</sup> The blend is expected to have a weighted 100-year GWP of approximately seven. *Trans*-1,2-dichloroethylene is a VOC and it is not exempted from the definition of VOC under CAA regulations (see 40 CFR 51.100(s)) addressing the development of SIPs to attain and maintain the NAAQS. Knowingly venting or releasing this refrigerant is limited by the venting prohibition under section 608(c)(2) of the CAA, codified at 40 CFR 82.154(a)(1).

*Flammability information:* Although the *trans*-dichloroethylene component of this blend is flammable, HFO-1336mzz(Z) is not flammable, and HFO-1336mzz(Z)/*trans*-1,2-dichloroethylene blend (74.7/25.3) as formulated and in the worst-case fractionation formulation is not flammable.

*Toxicity and exposure data:* Potential health effects of HFO-1336mzz(Z)/*trans*-1,2-dichloroethylene blend (74.7/25.3) include skin or eye irritation or frostbite. At

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<sup>12</sup> Patten and Wuebbles, 2010. “Atmospheric Lifetimes and Ozone Depletion Potentials of *trans*-1-chloro-3,3,3-trichloropropylene and *trans*-1,2-dichloroethylene in a three-dimensional model.” *Atmos. Chem. Phys.*, 10, 10867–10874, 2010.

<sup>13</sup> Patten and Wuebbles, 2010. *Op cit.*

sufficiently high concentrations, the substitute may cause irregular heartbeat. The substitute could cause asphyxiation if air is displaced by vapors in a confined space.

EPA anticipates that HFO-1336mzz(Z)/*trans*-1,2-dichloroethylene blend (74.7/25.3) will be used consistent with the recommendations specified in the SDS. *Trans*-dichloroethylene has an 8 hour/day, 40 hour/week PEL of 200 ppm required by OSHA. The WEEL committee of OARS recommends a WEEL for the workplace of 500 ppm on an 8-hour TWA for HFO-1336mzz(Z).<sup>14</sup> The manufacturer recommends an acceptable exposure limit (AEL) for the blend of 323 ppm on an 8-hour TWA. EPA anticipates that users will be able to meet the PEL, WEEL, and the AEL and address potential health risks by following requirements and recommendations in the SDS and other safety precautions common to the refrigeration and air conditioning industry.

*Comparison to other substitutes in these end-uses:* HFO-1336mzz(Z)/*trans*-1,2-dichloroethylene blend (74.7/25.3) has an ODP of approximately 0.00006, comparable<sup>15</sup> to or lower than other acceptable substitutes in these end-uses, with ODPs ranging from zero to 0.02.

In centrifugal and positive-displacement chillers, most other substitutes listed as acceptable have higher GWPs than HFO-1336mzz(Z)/*trans*-1,2-dichloroethylene blend (74.7/25.3), such as R-450A, R-513A, HFC-134a, R-404A and other HFC blends with GWPs ranging from approximately 600 to 3,990.<sup>16</sup> HFO-1336mzz(Z)/*trans*-1,2-

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<sup>14</sup> The documentation may be viewed at [www.tera.org/OARS/HFO-1336mzz-Z%20WEEL%20FINAL.pdf](http://www.tera.org/OARS/HFO-1336mzz-Z%20WEEL%20FINAL.pdf).

<sup>15</sup> In contrast, the historically used ODS CFC-11, CFC-12, and HCFC-22 have ODPs ranging from 0.055 to 1.

<sup>16</sup> In a proposed rule published April 18, 2016 (81 FR 22809), EPA proposed to change the status of a number of substitutes from acceptable to unacceptable for use in new centrifugal chillers and in new positive displacement chillers. Those substitutes had GWPs ranging from 920 to 3,990 in both end-uses. If

dichloroethylene blend (74.7/25.3)'s GWP of about seven is comparable to or higher than several other acceptable substitutes for new equipment within these end-uses, including ammonia absorption and ammonia vapor compression, HFO-1234ze(E) and, for centrifugal chillers only, *trans*-1-chloro-3,3,3-trifluoroprop-1-ene, with GWPs in the range of zero to seven.

Flammability and toxicity risks of this substitute are comparable to or lower than the flammability and toxicity risks of other available substitutes in the same end-uses. Flammability risks are low, as discussed above. Toxicity risks can be minimized by use consistent with the OSHA PEL, OARS WEEL, the manufacturer's recommended AEL, ASHRAE 15 and other industry standards, recommendations in the SDS, and other safety precautions common in the refrigeration and air conditioning industry.

EPA finds HFO-1336mzz(Z)/*trans*-1,2-dichloroethylene blend (74.7/25.3) acceptable in the end-uses listed above, because the overall environmental and human health risk posed by this substitute is lower than or comparable to the risks posed by other available substitutes in the same end-uses.

#### 4. R-513A

*EPA's decision: EPA finds R-513A acceptable as a substitute for use in:*

- Retail food refrigeration—refrigerated food processing and dispensing equipment (new and retrofit equipment)

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EPA takes final action as proposed, there would still be several substitutes that remain acceptable and that have higher GWPs than HFO-1336mzz(Z)/*trans*-1,2-dichloroethylene blend (74.7/25.3), including IKON B, R-450A, R-513A, and THR-02 for both end-uses, and for centrifugal chillers also IKON A, with GWPs ranging from approximately 30 to 630.



R-513A, marketed under the trade name Opteon® XP10, is a weighted blend of 44 percent HFC-134a, which is also known as 1,1,1,2 tetrafluoroethane (CAS Reg. No. 811-97-2); and 56 percent HFO-1234yf, which is also known as 2,3,3,3-tetrafluoroprop-1-ene (CAS Reg. No. 754-12-1).

You may find the redacted submission in Docket EPA-HQ-OAR-2003-0118 at [www.regulations.gov](http://www.regulations.gov) under the name, “SNAP Information Notice for Opteon® XP 10.” EPA performed assessments to examine the health and environmental risks of this substitute. These assessments are available in Docket EPA-HQ-OAR-2003-0118 under the following name:

- “Risk Screen on Substitutes for Use in Retail Food Refrigeration  
Substitute: R-513A”

*Environmental information:* R-513A has an ODP of zero. Its components, HFC-134a and HFO-1234yf, have GWPs of 1,430 and one to four,<sup>17</sup> respectively. If these values are weighted by mass percentage, then R-513A has a GWP of about 630. The components of R-513A are both excluded from the definition of VOC under CAA regulations (see 40 CFR 51.100(s)) addressing the development of SIPs to attain and maintain the NAAQS. Knowingly venting or releasing this refrigerant blend is limited by the venting prohibition under section 608(c)(2) of the CAA, codified at 40 CFR 82.154(a)(1).

*Flammability information:* R-513A as formulated and in the worst-case fractionation formulation is not flammable.

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<sup>17</sup> Hodnebrog *et al.*, 2013 and Nielsen *et al.*, 2007. *Op. cit.*

*Toxicity and exposure data:* Potential health effects of exposure to this substitute include drowsiness or dizziness. The substitute may also irritate the skin or eyes or cause frostbite. At sufficiently high concentrations, the substitute may cause irregular heartbeat. The substitute could cause asphyxiation if air is displaced by vapors in a confined space.

The AIHA has established WEELs of 1,000 ppm and 500 ppm as an 8-hour TWA for HFC-134a and HFO-1234yf, respectively, the components of R-513A. The manufacturer of R-513A recommends an AEL of 653 ppm on an 8-hour TWA for the blend. EPA anticipates that users will be able to meet each of the AIHA WEELs and the manufacturer's AEL, and address potential health risks by following requirements and recommendations in the SDS, in ASHRAE 15, and other safety precautions common to the refrigeration and air conditioning industry.

*Comparison to other substitutes in this end-use:* R-513A has an ODP of zero, comparable<sup>18</sup> to or lower than other listed substitutes in this end-use, with ODPs ranging from zero to 0.098.

R-513A's GWP of about 630 is comparable to or lower than most other substitutes in retail food refrigeration—refrigerated food processing and dispensing, including R-450A, HFC-134a, R-404A, R-407C, and a number of HFC blends, with GWPs ranging from approximately 600 to 3,920.<sup>19</sup> R-513A's GWP of about 630 is

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<sup>18</sup> This is in contrast to the historically used ODS CFC-12, R-502A, and HCFC-22 with ODPs ranging from 0.055 to 1.0.

<sup>19</sup> In a proposed rule published April 18, 2016 (81 FR 22809), EPA proposed to change the status of a number of substitutes from acceptable to unacceptable for use in new retail food refrigeration—refrigerated food processing and dispensing units. Those substitutes had GWPs ranging from 1,770 to 3,990. If EPA takes final action as proposed, there would still be several substitutes that remain acceptable and that have higher GWPs than R-513A, including FOR12A, FOR12B, HFC-134a, R-426A, RS-24 (2002 formulation), SP34E, THR-02 and THR-03, with GWPs ranging from approximately 920 to 1,510.

higher than those of some other acceptable substitutes in new retail food refrigeration—refrigerated food processing and dispensing units, including ammonia vapor compression with a secondary loop and CO<sub>2</sub> with GWPs of zero and one, respectively; these alternatives with lower GWP are not listed as acceptable for use in retrofit equipment.

Flammability and toxicity risks are comparable to or lower than flammability and toxicity risks of other available substitutes in the same end-use. Flammability risks are low, as discussed above. Toxicity risks can be minimized by use consistent with the AIHA WEELs, ASHRAE 15 and other industry standards, recommendations in the SDS, and other safety precautions common in the refrigeration and air conditioning industry.

EPA finds R-513A acceptable in the end-use listed above, because the overall environmental and human health risk posed by R-513A is lower than or comparable to the risks posed by other available substitutes in the same end-use.

## **II. Section 612 Program**

### *A. Statutory Requirements and Authority for the SNAP Program*

Section 612 of the CAA requires EPA to develop a program for evaluating alternatives to ozone-depleting substances. EPA refers to this program as the Significant New Alternatives Policy (SNAP) program. The major provisions of section 612 are:

#### 1. Rulemaking

Section 612(c) requires EPA to promulgate rules making it unlawful to replace any class I substance (CFC, halon, carbon tetrachloride, methyl chloroform, methyl bromide, hydrobromofluorocarbon, and chlorobromomethane) or class II substance

(HCFC) with any substitute that the Administrator determines may present adverse effects to human health or the environment where the Administrator has identified an alternative that (1) reduces the overall risk to human health and the environment, and (2) is currently or potentially available.

## 2. Listing of Unacceptable/Acceptable Substitutes

Section 612(c) requires EPA to publish a list of the substitutes unacceptable for specific uses and to publish a corresponding list of acceptable alternatives for specific uses. The list of “acceptable” substitutes is found at [www.epa.gov/snap/substitutes-sector](http://www.epa.gov/snap/substitutes-sector) and the lists of “unacceptable,” “acceptable subject to use conditions,” and “acceptable subject to narrowed use limits” substitutes are found in the appendices to 40 CFR part 82 subpart G.

## 3. Petition Process

Section 612(d) grants the right to any person to petition EPA to add a substance to, or delete a substance from, the lists published in accordance with section 612(c). The Agency has 90 days to grant or deny a petition. Where the Agency grants the petition, EPA must publish the revised lists within an additional six months.

## 4. 90-day Notification

Section 612(e) directs EPA to require any person who produces a chemical substitute for a class I substance to notify the Agency not less than 90 days before new or existing chemicals are introduced into interstate commerce for significant new uses as substitutes for a class I substance. The producer must also provide the Agency with the producer's unpublished health and safety studies on such substitutes.

## 5. Outreach

Section 612(b)(1) states that the Administrator shall seek to maximize the use of federal research facilities and resources to assist users of class I and II substances in identifying and developing alternatives to the use of such substances in key commercial applications.

## 6. Clearinghouse

Section 612(b)(4) requires the Agency to set up a public clearinghouse of alternative chemicals, product substitutes, and alternative manufacturing processes that are available for products and manufacturing processes which use class I and II substances.

### *B. EPA's Regulations Implementing Section 612*

On March 18, 1994, EPA published the initial SNAP rule (59 FR 13044) which established the process for administering the SNAP program and issued EPA's first lists identifying acceptable and unacceptable substitutes in the major industrial use sectors (subpart G of 40 CFR part 82). These sectors are the following: refrigeration and air conditioning; foam blowing; solvents cleaning; fire suppression and explosion protection; sterilants; aerosols; adhesives, coatings and inks; and tobacco expansion. These sectors comprise the principal industrial sectors that historically consumed the largest volumes of ODS.

Section 612 of the CAA requires EPA to list as acceptable those substitutes that do not present a significantly greater risk to human health and the environment as compared with other substitutes that are currently or potentially available.

### *C. How the Regulations for the SNAP Program Work*

Under the SNAP regulations, anyone who plans to market or produce a substitute to replace a class I substance or class II substance in one of the eight major industrial use sectors must provide the Agency with notice and the required health and safety information on the substitute at least 90 days before introducing it into interstate commerce for significant new use as an alternative (40 CFR 82.176(a)). While this requirement typically applies to chemical manufacturers as the entity likely to be planning to introduce the substitute into interstate commerce,<sup>20</sup> it may also apply to importers, formulators, equipment manufacturers, and end users<sup>21</sup> when they are responsible for introducing a substitute into commerce. The 90-day SNAP review process begins once EPA receives the submission and determines that the submission includes complete and adequate data (40 CFR 82.180(a)). The CAA and the SNAP regulations, 40 CFR 82.174(a), prohibit use of a substitute earlier than 90 days after notice has been provided to the agency.

The Agency has identified four possible decision categories for substitute submissions: acceptable; acceptable subject to use conditions; acceptable subject to narrowed use limits; and unacceptable (40 CFR 82.180(b)).<sup>22</sup> Use conditions and

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<sup>20</sup> As defined at 40 CFR 82.104, “interstate commerce” means the distribution or transportation of any product between one state, territory, possession or the District of Columbia, and another state, territory, possession or the District of Columbia, or the sale, use or manufacture of any product in more than one state, territory, possession or District of Columbia. The entry points for which a product is introduced into interstate commerce are the release of a product from the facility in which the product was manufactured, the entry into a warehouse from which the domestic manufacturer releases the product for sale or distribution, and at the site of United States Customs clearance.

<sup>21</sup> As defined at 40 CFR 82.172, “end-use” means processes or classes of specific applications within major industrial sectors where a substitute is used to replace an ODS.

<sup>22</sup> The SNAP regulations also include “pending,” referring to submissions for which EPA has not reached a determination, under this provision.

narrowed use limits are both considered “use restrictions” and are explained below. Substitutes that are deemed acceptable without use conditions may be used for all applications within the relevant end-uses within the sector and without limits under SNAP on how they may be used. Substitutes that are acceptable subject to use restrictions may be used only in accordance with those restrictions. Substitutes that are found to be unacceptable may not be used after the date specified in the rulemaking adding such substitute to the list of unacceptable substitutes.<sup>23</sup>

After reviewing a substitute, the Agency may make a determination that a substitute is acceptable only if certain conditions in the way that the substitute is used are met to minimize risks to human health and the environment. EPA describes such substitutes as "acceptable subject to use conditions." Entities that use these substitutes without meeting the associated use conditions are in violation of EPA’s SNAP regulations (40 CFR 82.174(c)).

For some substitutes, the Agency may permit a narrowed range of use within an end-use or sector. For example, the Agency may limit the use of a substitute to certain end-uses or specific applications within an industry sector. The Agency generally requires a user of a substitute subject to narrowed use limits to demonstrate that no other acceptable substitutes are available for their specific application.<sup>24</sup> EPA describes these

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<sup>23</sup> As defined at 40 CFR 82.172, “use” means any use of a substitute for a Class I or Class II ozone-depleting compound, including but not limited to use in a manufacturing process or product, in consumption by the end-user, or in intermediate uses, such as formulation or packaging for other subsequent uses. This definition of use encompasses manufacturing process of products both for domestic use and for export. Substitutes manufactured within the United States exclusively for export are subject to SNAP requirements since the definition of use in the rule includes use in the manufacturing process, which occurs within the United States.

<sup>24</sup> In the case of the July 20, 2015, final rule, EPA established narrowed use limits for certain substitutes over a limited period of time for specific MVAC and foam applications, on the basis that other acceptable

substitutes as “acceptable subject to narrowed use limits.” A person using a substitute that is acceptable subject to narrowed use limits in applications and end-uses that are not consistent with the narrowed use limit is using the substitute in violation of section 612 of the CAA and EPA’s SNAP regulations (40 CFR 82.174(c)).

The section 612 mandate for EPA to prohibit the use of a substitute that may present risk to human health or the environment where a lower risk alternative is available or potentially available<sup>25</sup> provides EPA with the authority to change the listing status of a particular substitute if such a change is justified by new information or changed circumstance.

As described in this document and elsewhere, including the initial SNAP rule published in the Federal Register at 59 FR 13044 on March 18, 1994, the SNAP program evaluates substitutes within a comparative risk framework. The SNAP program compares new substitutes both to the ozone-depleting substances being phased out under the *Montreal Protocol on Substances that Deplete the Ozone Layer* and the CAA, and to other available or potentially available alternatives for the same end-uses. The environmental and health risk factors that the SNAP program considers include ozone depletion potential, flammability, toxicity, occupational and consumer health and safety, as well as contributions to global warming and other environmental factors.

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alternatives would not be available for those specific applications within broader end-uses, but acceptable alternatives were expected to become available over time, e.g., after military qualification testing for foam blowing agents in military applications or after development of improved servicing infrastructure in a destination country for MVAC in vehicles destined for export.

<sup>25</sup> In addition to acceptable commercially available substitutes, the SNAP program may consider potentially available substitutes. The SNAP program’s definition of “potentially available” is “any alternative for which adequate health, safety, and environmental data, as required for the SNAP notification process, exist to make a determination of acceptability, and which the agency reasonably believes to be technically feasible, even if not all testing has yet been completed and the alternative is not yet produced or sold.” (40 CFR 82.172)



Environmental and human health exposures can vary significantly depending on the particular application of a substitute – and over time, information applicable to a substitute can change. This approach does not imply fundamental tradeoffs with respect to different types of risk, either to the environment or to human health. Over the past twenty years, the menu of substitutes has become much broader and a great deal of new information has been developed on many substitutes. Because the overall goal of the SNAP program is to ensure that substitutes listed as acceptable do not pose significantly greater risk to human health and the environment than other available substitutes, the SNAP criteria should be informed by our current overall understanding of environmental and human health impacts and our experience with and current knowledge about available and potentially available substitutes. Over time, the range of substitutes reviewed by SNAP has changed, and, at the same time, scientific approaches have evolved to more accurately assess the potential environmental and human health impacts of these chemicals and alternative technologies. The Agency publishes its SNAP program decisions in the Federal Register. EPA uses notice-and-comment rulemaking to place any alternative on the list of prohibited substitutes, to list a substitute as acceptable only subject to use conditions or narrowed use limits, or to remove a substitute from either the list of prohibited or acceptable substitutes.

In contrast, EPA publishes “notices of acceptability” or “determinations of acceptability,” to notify the public of substitutes that are deemed acceptable with no restrictions. As described in the preamble to the rule initially implementing the SNAP program (59 FR 13044; March 18, 1994), EPA does not believe that rulemaking

procedures are necessary to list alternatives that are acceptable without restrictions because such listings neither impose any sanction nor prevent anyone from using a substitute.

Many SNAP listings include “comments” or “further information” to provide additional information on substitutes. Since this additional information is not part of the regulatory decision, these statements are not binding for use of the substitute under the SNAP program. However, regulatory requirements so listed are binding under other regulatory programs (e.g., worker protection regulations promulgated by OSHA). The “further information” classification does not necessarily include all other legal obligations pertaining to the use of the substitute. While the items listed are not legally binding under the SNAP program, EPA encourages users of substitutes to apply all statements in the “further information” column in their use of these substitutes. In many instances, the information simply refers to sound operating practices that have already been identified in existing industry and/or building codes or standards. Thus many of the statements, if adopted, would not require the affected user to make significant changes in existing operating practices.

#### *D. Additional Information about the SNAP Program*

For copies of the comprehensive SNAP lists of substitutes or additional information on SNAP, refer to EPA’s Ozone Depletion website at: [www.epa.gov/snap](http://www.epa.gov/snap). For more information on the agency's process for administering the SNAP program or criteria for evaluation of substitutes, refer to the initial SNAP rulemaking published March 18, 1994

(59 FR 13044), codified at 40 CFR part 82, subpart G. SNAP decisions and the appropriate Federal Register citations are found at: [www.epa.gov/snap/snap-regulations](http://www.epa.gov/snap/snap-regulations).

**List of Subjects in 40 CFR Part 82**

Environmental protection, Administrative practice and procedure, Air pollution control, Reporting and recordkeeping requirements.

Date: May 17, 2016.

Sarah Dunham, Director  
Office of Atmospheric Programs

## APPENDIX A: SUMMARY OF DECISIONS FOR NEW ACCEPTABLE SUBSTITUTES

### **Refrigeration and Air Conditioning**

End-Use	Substitute	Decision	Further Information <sup>1</sup>
Centrifugal chillers ( <i>new only</i> ).	Carbon dioxide (CO <sub>2</sub> or R-744)	Acceptable	<p>CO<sub>2</sub> has no ozone depletion potential (ODP) and a global warming potential (GWP) of 1.</p> <p>The Occupational Safety and Health Administration (OSHA) has established a required 8-hour (8-hr) time-weighted average (TWA) permissible exposure limit (PEL) for CO<sub>2</sub> of 5,000 ppm. The National Institute for Occupational Safety and Health (NIOSH) has established a 15-minute recommended short-term exposure limit (STEL) of 30,000 ppm.</p> <p>CO<sub>2</sub> is nonflammable.</p> <p>EPA recommends that users follow all requirements and recommendations specified in American Society for Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) standard 15.</p>
	HFO-1336mzz(Z) ((Z)-1,1,1,4,4,4-hexafluorobut-2-ene)	Acceptable	<p>HFO-1336mzz(Z) (CAS Reg. No. 692-49-9) has no ODP and a 100-year GWP of roughly 9.</p> <p>This compound is nonflammable.</p> <p>The Occupational Alliance for Risk Science (OARS) recommends a Workplace Environmental Exposure Limit (WEEL) of 500 ppm (8-hr TWA) for HFO-1336mzz(Z).</p>

End-Use	Substitute	Decision	Further Information <sup>1</sup>
Centrifugal chillers ( <i>new and retrofit equipment</i> ).	HFO-1336mzz(Z)/ <i>trans</i> -1,2-dichloroethylene blend (74.7/25.3) (proposed R-514A)	Acceptable	<p>HFO-1336mzz(Z)/<i>trans</i>-1,2-dichloroethylene blend (74.7/25.3) has an ODP value of approximately 0.00006 and an estimated 100-year GWP of approximately 7. This substitute is a blend of 74.7 percent HFO-1336mzz(Z), also known as (Z)-1,1,1,4,4,4-hexafluoro-but-2-ene and <i>cis</i>-1,1,1,4,4,4-hexafluorobut-2-ene (CAS Reg. No. 692-49-9), and 25.3 percent <i>trans</i>-1,2-dichloroethylene (CAS Reg. No. 156-60-5).</p> <p>The blend is nonflammable.</p> <p>OSHA has established an 8-hr TWA PEL of 200 ppm for <i>trans</i>-dichloroethylene. OARS recommends a WEEL of 500 ppm (8-hr TWA) for HFO-1336mzz(Z). The manufacturer recommends an acceptable exposure limit (AEL) for the workplace for HFO-1336mzz(Z)/<i>trans</i>-1,2-dichloroethylene blend (74.7/25.3) of 323 ppm (8-hr TWA).</p>
Heat transfer ( <i>new and retrofit equipment</i> ).	HFO-1336mzz(Z) ((Z)-1,1,1,4,4,4-hexafluorobut-2-ene)	Acceptable	<p>HFO-1336mzz(Z) (CAS Reg. No. 692-49-9) has no ODP and a 100-year GWP of roughly 9.</p> <p>This compound is nonflammable.</p> <p>OARS recommends a WEEL of 500 ppm (8-hr TWA) for HFO-1336mzz(Z).</p>
Ice skating rinks ( <i>new only</i> ).	Carbon dioxide (CO <sub>2</sub> or R-744)	Acceptable	<p>CO<sub>2</sub> has no ODP and a GWP of 1.</p> <p>OSHA has established an 8-hr TWA PEL for CO<sub>2</sub> of 5,000 ppm. NIOSH has established a 15-minute TWA recommended STEL of 30,000 ppm.</p> <p>CO<sub>2</sub> is nonflammable.</p> <p>EPA recommends that users follow all requirements and recommendations specified in ASHRAE standard 15.</p>

End-Use	Substitute	Decision	Further Information <sup>1</sup>
Industrial process air conditioning ( <i>new only</i> ).	Carbon dioxide (CO <sub>2</sub> or R-744)	Acceptable	CO <sub>2</sub> has no ODP and a GWP of 1.  OSHA has established an 8-hr TWA PEL for CO <sub>2</sub> of 5,000 ppm. NIOSH has established a 15-minute TWA recommended STEL of 30,000 ppm.  CO <sub>2</sub> is nonflammable.  EPA recommends that users follow all requirements and recommendations specified in ASHRAE standard 15.
	HFO-1336mzz(Z) ((Z)-1,1,1,4,4,4-hexafluorobut-2-ene)	Acceptable	HFO-1336mzz(Z) (CAS Reg. No. 692-49-9) has no ODP and a 100-year GWP of roughly 9.  This compound is nonflammable.  OARS recommends a WEEL of 500 ppm (8-hr TWA) for HFO-1336mzz(Z).
Positive displacement chillers ( <i>new only</i> ).	Carbon dioxide (CO <sub>2</sub> or R-744)	Acceptable	CO <sub>2</sub> has no ODP and a GWP of 1.  OSHA has established an 8-hr TWA PEL for CO <sub>2</sub> of 5,000 ppm. NIOSH has established a 15-minute TWA recommended STEL of 30,000 ppm.  CO <sub>2</sub> is nonflammable.  EPA recommends that users follow all requirements and recommendations specified in ASHRAE standard 15.
	HFO-1336mzz(Z) ((Z)-1,1,1,4,4,4-hexafluorobut-2-ene)	Acceptable	HFO-1336mzz(Z) (CAS Reg. No. 692-49-9) has no ODP and a 100-year GWP of roughly 9.  This compound is nonflammable.  OARS recommends a WEEL of 500 ppm (8-hr TWA) for HFO-1336mzz(Z).

End-Use	Substitute	Decision	Further Information <sup>1</sup>
Positive displacement chillers ( <i>new and retrofit equipment</i> ).	HFO-1336mzz(Z)/ <i>trans</i> -1,2-dichloroethylene blend (74.7/25.3) (proposed R-514A)	Acceptable	<p>HFO-1336mzz(Z)/<i>trans</i>-1,2-dichloroethylene blend (74.7/25.3) has an ODP value of approximately 0.00006 and an estimated 100-year GWP of approximately 7. This substitute is a blend of 74.7 percent HFO-1336mzz(Z), also known as (Z)-1,1,1,4,4,4-hexafluoro-but-2-ene and <i>cis</i>-1,1,1,4,4,4-hexafluorobut-2-ene (CAS Reg. No. 692-49-9), and 25.3 percent <i>trans</i>-1,2-dichloroethylene (CAS Reg. No. 156-60-5).</p> <p>The blend is nonflammable.</p> <p>OSHA has established an 8-hr TWA PEL of 200 ppm for <i>trans</i>-dichloroethylene. OARS recommends a WEEL of 500 ppm (8-hr TWA) for HFO-1336mzz(Z). The manufacturer recommends an AEL for the workplace for the HFO-1336mzz(Z)/<i>trans</i>-1,2-dichloroethylene blend (74.7/25.3) of 323 ppm (8-hr TWA).</p>
Retail food refrigeration ( <i>new and retrofit refrigerated food processing and dispensing equipment</i> )	R-513A	Acceptable	<p>R-513A has no ODP and a 100-year GWP of approximately 630. This substitute is a blend of HFC-134a, which is also known as 1,1,1,2-tetrafluoroethane (CAS Reg. No. 811-97-2); and HFO-1234yf, which is also known as 2,3,3,3-tetrafluoroprop-1-ene (CAS Reg. No. 754-12-1).</p> <p>This blend is nonflammable.</p> <p>The AIHA has established WEELs of 1,000 ppm and 500 ppm (8-hr TWA) for HFC-134a and HFO-1234yf, respectively. The manufacturer recommends an AEL for the workplace for R-513A of 653 ppm (8-hr TWA).</p>

<sup>1</sup> Observe recommendations in the manufacturer's SDS and guidance for all listed refrigerants.